(5) Agriculture, with six departments; (6) Applied Chemistry, with four departments; (7) Physics, with two departments; (8) Fine Arts, with three departments; (9) Business, with four departments; (10) Navigation and Marine Transportation, with two departments; (11) Mathematics, with two departments; (12) Politics and Ecomomics, with four departments; (13) Languages and Literature, with four departments; (14) Philosophical Science and Ethics; (15) Biology; (16) The Preparatory College (standard curriculum).

In his presidental address to the section of social and economical science, Prof. C. M. Woodward referred to the report of the advisory committee on the Carnegie Technical School in the following terms:—"For a variety of excellent reasons the committee reaches the conclusion that some new kind of preparation for the work of life must be introduced into the school training of both boys and girls. It then proceeds to outline a technical college, a technical high school and an artisan day and evening school, which are to meet this demand.

"The artisan day and evening school is somewhat of the order of German and English low-grade technical schools. I earnestly hope that the suggestion of this school may be adopted that the experiment may be fairly tried in America. The plan for a technical college is in complete harmony with the best engineering schools.

"The scheme for a technical high school, however, seems to me faulty. This school would be of high-school grade, taking pupils from the grammar schools and covering presumably four years. The normal ages of entrance and graduation would accordingly be fourteen and eighteen. Three things in the committee's outline of this technical high school deserve attention: (1) The elective principle is to be recognised, the student selecting the required number of courses under the direction of the director of the school. Here the pupil at a tender age (only fourteen or fifteen) is asked to surrender his birthright to the privilege of choice when he is eighteen.

"(2) The course in mathematics—which begins with elementary algebra—is to include the elements of calculus! Of course, it must include solid geometry, higher algebra, trigonometry and analytical geometry! One rarely meets with such an astounding proposition from engineers who are supposed to have studied mathematics and to know what they are talking about. They might as well propose that the pupils shall take thermodynamics in a short course of lectures. To be sure, similar ambitious schemes have been proposed elsewhere for boys just out of the grammar school, but they came from people who could have known very little mathematics, and nothing of the uses of the calculus. This criticism may seem trivial, but in more than one place the scheme attempts too much.

"(3) The technical studies suggested take the form of trade work or special employments, with well equipped shops and experimental laboratories under the direction of expert artisans.

"What Mr. Carnegie will do with this last suggestion remains to be seen, but any attempt to embody it in a real technical high school of secondary grade will be full of interest to the educational world. If any man was well prepared to give the scheme a fair trial, that man is Andrew Carnegie; but it will cost a vast amount of money and its experience will teach us how not to do many things.

"I have high respect for the members of the advisory committee, but I think a less ambitious scheme would be more successful. You cannot teach the higher mathematics in a high school, and I have no great faith in the value of attempts to teach employments, commercial or industrial, within the limits of any secondary school. Such attempts are certain to mislead and ultimately hinder those they aim to help. Any trade or special employment must be dwarfed and narrowed before it can be brought down to the grasp of an untrained boy, and its very narrowness unfits it for the best educational uses.

"The school is the place where one should learn the fundamental unchanging laws and manifestations of force and materials. Special occupations, like special constructions, should be analysed in their elements, and pupils should become expert in such analyses, in so far as they involve universal elements that pupils can comprehend. But there are many things essential to a business employment, which cannot even be apprehended in school."

From the foregoing it will be seen that much difference of opinion exists as to the nature and extent of the subjects which should be included in the curriculum of a large technical school. Three different and distinct forms of school, which may be combined as parts of one complete technical university, have been proposed. If the whole scheme is accepted by Mr. Carnegie, there will be, in the first place, a first-class technical college. "This college," says the committee, "should be made attractive to the greatest scholars in the fields of physical and chemical science. To obtain and hold such men they must be given ample opportunities for research. This college must be supplied, therefore, not only with great experimental shops and laboratories for students' use, but in all departments there should be splendidly equipped laboratories of investigation and research, under the direction of the head of such department, and with a full corps of assistants for the carrying on of all lines of investigation which are now partly or wholly unprovided for in America." There will also be a Technical High School to carry on work above that of the public grammar school, and day and evening classes for the benefit of those who are unable to take advantage of the more complete courses in this school. Mr. Carnegie has now to decide whether he will found a school for artisans, a technical high school or a technical college, or, if his ambition mounts so high, a true technical university including them all.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE building fund of 150,000*l.*, which it is proposed to raise for the Glasgow and West of Scotland Technical College, has reached about 100,000*l.*, and Mr. Carnegie has promised to subscribe one-half the deficiency upon the condition that the other half is promptly obtained.

THE position of science and technical instruction in schools inspected by officers of the Secondary Branch of the Board of Education can be seen in vol. ii. of the Report just issued by the Board, containing extracts from the inspectors' reports for the year 1900. Improvement is manifest in the larger technical schools in the teaching of advanced science. General improvement is also reported in the mode of teaching experimental science. "Moreover," remarks Mr. A. E. Tutton, F.R.S., "the influence of the advocates of the heuristic method of teaching has proved to be so far effective that the general attention of teachers has been directed to the educative value of calling forth the highest thinking and experimenting powers of their pupils." Dr. H. H. Hoffert also reports that "there is amongst the teachers a widely spread spirit of enthusiastic eagerness to ascertain the best methods of instruction and to apply them in their own schools." The movement for reform is being felt in the teaching of mathematics, and Mr. J. Brill contributes a short special report upon the subject to the volume just issued. The work being done in the Schools of Science is favourably reported upon by all the inspectors. In these schools five or six hours a week are given to experimental science, two or three to drawing and geometry, about five to mathematics, and eight or ten to literary subjects. Beyond this minimum requirement the extra time at the disposal of the school is given to languages, to science, to commercial subjects, or to manual occupations according to the particular type of the school. In fact, these schools possess a curriculum which is adapted to modern requirements, and in most of them excellent work is being done, not only in science and art, but also in literary subjects.

A FULL report of the opening of the Harper-Adams Agricultural College at Edgmond, Newport, by Mr. Hanbury, the President of the Board of Agriculture, appears in the *Newport and Market Drayton Advertiser* of September 28. The College owes its establishment to the late Mr. Thomas Harper-Adams, who left a large sum of money and an estate in order to found it. It is provided with lecture rooms and laboratories in which work can be carried on in physics, chemistry, biology, and other sciences connected with agriculture. The farm attached to the College is about 180 acres in extent and is intended for experimental purposes; and all the work will be arranged with the object of instructing students in the practical management of a farm on modern business lines. The Salop County Council make a grant of 1000*l.* a year towards the College funds, and together with the Stafford County Council offer a certain number of scholarships tenable at the College. The Principal is Mr. P. Hedworth Foulkes. In opening the College, Mr. Hanbury referred to the small sum available for agricultural education. At present the Board of Agriculture had to spend, in grants, the small sum of 8000*l.* for the whole of the United Kingdom. In France, for the same purpose, 153,000*l.*

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is granted by the State. In Denmark, 108,000*l.* is granted; in Canada, 156,000*l.*; and in the United States, 26,000*l.* Moreover, a comparison of the assistance given to agriculture with that given to the towns shows that out of the Science and Art grants given by the Board of Education, no less than 505*l.* out of 506*l.* goes to the towns, and only 1*l.* to the rural population. Referring to the value of agricultural colleges and scientific work to the practical farmer, Mr. Hanbury remarked that it was sometimes asked, What is the good of science? He took science to mean this, however practical a man might be, it was impossible for him, in his own experience, to have learned everything. What science meant was, that other people had been experimenting, and had found that those experiments had been a success, and that it made money to work in that way. He therefore asked them not to be afraid of the word "science"; and, above all, not to think, because they were practical men, that they knew everything, for there was no trade in the world in which there was any man who had occupied the whole region of science, or the whole region of knowledge. He thought they made a mistake in making experiments over and over again. He was a little afraid the County Councils, in too many instances, were going over the same ground over and over again. What was to be of some use to farmers was that those experiments had been made, and the results proved to be true. He should like to see more demonstrations made all over the country—not mere pocket handkerchief demonstrations over a small field, but, if they were to be any good, over several fields of a farm.

SCIENTIFIC SERIAL.

American Journal of Mathematics, vol. xxiii. No. 4.—Memoir on the algebra of symbolic logic is the second part of a paper by Mr. A. N. Whitehead, which treats of the theory of substitutions under the heads, types of transformation, relations between the coefficients of a substitution, the reverse substitution, the group of substitutions, substitutions satisfying special conditions, congruence of functions, the identical group of a function, and common subgroups of identical groups.—Secular perturbations of the planets, by G. W. Hill, follows up Halphen's presentation of Gauss' procedure (*Werke*, vol. iii. pp. 331–355). The author thinks that, though a remarkable degree of elegance is attained by Halphen's changes, additional statements are needed to show the connection with the astronomical problem which originally suggested the investigation; for Halphen, like Gauss, treats only the attraction of a certain form of ring. This ignores the second integration which the problem demands. The present memoir attempts to supply the lacuna.—Representation of linear groups as transitive substitution groups, by L. E. Dickson, is a piece of work on the well-known lines of this mathematician.—A class of number-systems in six units, by G. P. Starkweather, is a further contribution to the same subject which was treated of by the author in vol. xxi. No. 4.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 16.—M. Bouquet de la Grye in the chair.—Demonstration and use of the formulæ relating to the refractometer, by M. A. Cornu.—On the elastic arch, by M. G. Poisson.—On the simultaneous employment of multiplex and ordinary telegraphy in the same circuit, by M. E. Mercadier.—On the molecular weight of chloral hydrate at the temperature of its boiling point, by M. de Forcrand. By a discussion of thermochemical data the author arrives at the conclusion that at the boiling point chloral hydrate is not totally dissociated, from 4 to 5 per cent. remaining undissociated.—On dunite from Koswinsky-Kamen, in the Ural, by MM. K. Duparc and F. Pearce. The results of a microscopical and chemical study of the dunites from this district.—A new cave with drawings on its walls of the Palæolithic period, by MM. L. Capitan and H. Breuil. An account of the discovery of a cave situated at Combarelles, in Tayac (Dordogne), about two kilometres from the Mouthe cave. The cave is about 225 metres long, and about 119 metres from the entrance drawings can be seen on the walls, which continue to the end of the cave. They are engraved upon a cretaceous rock, but the greater number are covered with a stalagmitic deposit, which is sometimes so thick that the lines cannot be seen through it. No less than 109 figures can be clearly made out, including drawings of the horse, cow, bison, reindeer, mammoth, and wild goat. It would appear that these drawings, the antiquity of which cannot be doubted, could only have been executed by artists reproducing animals that they saw. Hence they are clearly Palæolithic, and go back to the epoch when the mammoth and the reindeer lived in France.—Luminous rays diverging at 180° from the sun, by M. Jean Mascart.

September 23.—Binary systems and couples of kinematic elements, by M. G. Kœnigs.—Lecithin in tuberculosis, by MM. H. Claude and A. Zaky. Experiments on animals and on man showed that lecithin, owing to its specific action on the elimination of phosphates by the urine, has a remarkable action on the nutritive exchanges, and it must be considered as a valuable adjunct to the various modes of treatment of tuberculosis.—On the ravages of the pyralis in the Beaujolais, and on the destruction of the night moths by means of luminous traps fed with acetylene, by MM. G. Gastine and V. Vermorel. The traps consisted of basins containing water covered with a layer of oil, above the centre of which was placed a small acetylene lamp to attract the insects. By this method between August 13 and 31 no less than 170,000 pyrales were destroyed.—The distribution of acidity in the stem, leaf, and flower, by M. A. Astruc. The acidity of the stem diminishes with the distance from the top In the case of the leaves the acidity is greatest in the youngest leaves, and in general it is always the youngest parts of the plant which present the maximum acidity.—A new cave with figures on its walls of the Palæolithic period, by MM. L. Capitan and H. Breuil. A description of the drawings on walls of a cave at Font-de-Gaume, situated in the valley of the Beune, about two kilometres from the cave of Combarelles. The drawings consist largely of animals, of species resembling those represented in the cave of Combarelles. These drawings are noteworthy for the fact that different colours have been used, black, red, and brown. They are probably not so ancient as the drawings on the walls of the cave at Combarelles.

NEW SOUTH WALES.

Royal Society, August 7.—Prof. T. W. Edgeworth David, F.R.S., vice-president, in the chair.—Notes on some analyses of air from coal mines, by A. A. Atkinson and F. B. Guthrie. The authors gave the analyses of several samples of air from the return air-ways at Wallsend and Burwood collieries, and of gases produced by fires in the Gunnedah and Greta collieries, the latter was an old gob. fire. The analyses were compared with published analyses of air in the return-ways of English collieries made by Dr. Haldane, and the question of the effects of diminution of oxygen, presence of carbonic acid, black-damp and other injurious gases found in the air of coal-mines, discussed in relation to their action on men and lights.—Symmetrically distorted crystals of Cassiterite from Western Australia, by W. G. Woolnough.

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